CLAIMS

What is claimed is:

1. A method for producing hydrocarbons from syngas in a three-phase system in which the catalyst comprises solid particles, comprising:

(a) providing a reactor containing the catalyst;

(b) feeding the syngas into the reactor so as to generate a liquid product;

(c) operating the three-phase system in a well-mixed gas flow regime, with a gas Peclet number less than 0.175 and a single pass conversion between 35 % and 75 %; and

(d) removing hydrocarbons from the reactor.

2. The method according to claim 1 wherein the inlet superficial gas velocity is at least 20 cm/sec.

3. The method according to claim 1 wherein the reactor includes a recycle line.

4. The method according to claim 1 wherein the process comprises multiple stages and in which each stage may have one or more reactors, and wherein the inlet gas superficial velocity is at least 20 cm/sec and syngas per pass conversion in each reactor is between 35 % and 75 %.

5. The method according to claim 4 wherein the overall syngas conversion is at least 90%.

6. The method according to claim 1 wherein the gas hourly space velocity through the reactor is between about 50 volumes/hour/volume of expanded bed (v/hr/v) and about 10,000 v/hr/v.

7. The method according to claim 1 wherein the gas hourly space velocity through the reactor is between about 300 v/hr/v and about 2,000 v/hr/v.

8. The method according to claim 1 wherein step (c) is carried out between about 160°C and about 300°C.

9. The method according to claim 1 wherein step (c) is carried out between about 190°C and about 260°C.

10. The method according to claim 1 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 1000 psig (6994 kPa).

11. The method according to claim 1 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 600 psig (4237 kPa).

12. The method according to claim 1 wherein the pressure in the reactor is between about 140 psig (1066 kPa) and about 500 psig (3497 kPa).

13. The method according to claim 1 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is greater than 0.5:1.

14. The method according to claim 1 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is between about 0.67:1 and about 2.5:1.

15. The method according to claim 1 wherein the hydrocarbons in step (d) comprise C_1 to C_{80+} hydrocarbons.

16. The method according to claim 1 wherein the catalyst comprises a supported or precipitated cobalt catalyst.

17. A method for operating a Fischer-Tropsch reactor system containing solid catalyst, gaseous feed, and gas and liquid products, comprising maintaining the rates of gaseous feed and liquid withdrawal such that the reactor system is maintained in a well-mixed gas flow regime described by

$$U_G \leq 0.175 D_G/L,$$

where U_G is the inlet superficial gas velocity, L is the expanded slurry bed height, and D_G is the dispersion coefficient.

18. The method according to claim 17 wherein the inlet superficial gas velocity is at least 20 cm/sec.

19. The method according to claim 17 wherein the expanded slurry bed height is at least 60 % of the total reactor height.

20. The method according to claim 17 wherein the process comprises multiple stages and in which each stage may have one or more reactors, and wherein the inlet gas superficial velocity is at least 20 cm/sec and syngas per pass conversion in each reactor is between 35 % and 75

21. The method according to claim 20 wherein the overall syngas conversion is at least 90%.

22. The method of claim 17 wherein the expanded bed height is at least 60 % of the total reactor height.

23. The method according to claim 17 wherein the gas hourly space velocity through the reactor is between about 50 volumes/hour/volume of expanded bed (v/hr/v) and about 10,000 v/hr/v.

24. The method according to claim 17 wherein the gas hourly space velocity through the reactor is between about 300 v/hr/v and about 2,000 v/hr/v.

25. The method according to claim 17 wherein the reactor system is maintained between about 160°C and about 300°C.

26. The method according to claim 17 wherein the reactor system is maintained about 190°C and about 260°C.

27. The method according to claim 17 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 1000 psig (6994 kPa).

28. The method according to claim 17 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 600 psig (4237 kPa).

29. The method according to claim 17 wherein the pressure in the reactor is between about 140 psig (1066 kPa) and about 500 psig (3497 kPa).

30. The method according to claim 17 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is greater than 0.5:1.

31. The method according to claim 17 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is between about 0.67:1 and about 2.5:1.

32. The method according to claim 17 wherein the Fischer-Tropsch reactor system produces hydrocarbons comprising C_1 to C_{80+} hydrocarbons.

33. The method according to claim 17 wherein the catalyst comprises a supported or precipitated cobalt catalyst.

34. A hydrocarbon stream prepared by operating a Fischer-Tropsch reactor system containing solid catalyst, gaseous feed, and gas and liquid products in a well-mixed gas flow regime described by

$$U_G \leq 0.175 D_G/L,$$

where U_G is the inlet superficial gas velocity, L is the expanded slurry bed height, and D_G is the dispersion coefficient, wherein the is well-mixed gas flow regime is maintained by controlling the rates of gaseous feed and liquid withdrawal.

35. The hydrocarbon stream according to claim 34 wherein the inlet superficial gas velocity is at least 20 cm/sec.

36. The hydrocarbon stream according to claim 34 wherein the expanded slurry bed height is at least 60 % of the total reactor height.

37. The hydrocarbon stream according to claim 34 wherein the process comprises multiple stages and in which each stage may have one or more reactors, and wherein the inlet gas superficial velocity is at least 20 cm/sec and syngas per pass conversion in each reactor is between 35 % and 75

38. The hydrocarbon stream according to claim 37 wherein the overall syngas conversion is at least 90%.

39. The hydrocarbon stream of claim 34 wherein the expanded bed height is at least 60 % of the total reactor height.

40. The hydrocarbon stream according to claim 34 wherein the gas hourly space velocity through the reactor is between about 50 volumes/hour/volume of expanded bed (v/hr/v) and about 10,000 v/hr/v.

41. The hydrocarbon stream according to claim 34 wherein the gas hourly space velocity through the reactor is between about 300 v/hr/v and about 2,000 v/hr/v.

42. The hydrocarbon stream according to claim 34 wherein the reactor system is maintained between about 160°C and about 300°C.

43. The hydrocarbon stream according to claim 34 wherein the reactor system is maintained between about 190°C and about 260°C.

44. The hydrocarbon stream according to claim 34 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 1000 psig (6994 kPa).

45. The hydrocarbon stream according to claim 34 wherein the pressure in the reactor is between about 80 psig (653 kPa) and about 600 psig (4237 kPa).

46. The hydrocarbon stream according to claim 34 wherein the pressure in the reactor is between about 140 psig (1066 kPa) and about 500 psig (3497 kPa).

47. The hydrocarbon stream according to claim 34 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is greater than 0.5:1.

48. The hydrocarbon stream according to claim 34 wherein the mole ratio of hydrogen to carbon monoxide in the syngas is between about 0.67:1 and about 2.5:1.

49. The hydrocarbon stream according to claim 34 wherein the Fischer-Tropsch reactor system produces hydrocarbons comprising C_1 to C_{80+} hydrocarbons.

50. The hydrocarbon stream according to claim 34 wherein the catalyst comprises a supported or precipitated Co catalyst.